

GIS-BASED STATEWIDE INVENTORY FOR WYOMING

Chris Arneson, TriHydro Corporation, Laramie, WY 82070, carneson@trihydro.com
Evan Green, Wyoming Dept. of Environmental Quality, Abandoned Mine Lands Division,
Cheyenne, WY 82001
Jack Bedessem, TriHydro Corporation, Laramie, WY 82070

ABSTRACT

The Wyoming Department of Environmental Quality Abandoned Mine Lands Division (WDEQ/AML) required a comprehensively updated statewide database and an efficient method of accessing, querying, and utilizing this information for project management, budgeting, and decision-making purposes. A customized Geographic Information System (GIS) application was envisioned and developed to serve as a user interface to WDEQ/AML's MS Access database, which was subject to updating through an ongoing inventory project. This application was built in an ArcView GIS software environment, which provides users with an up-to-date status of AML sites, a user-friendly query system, a single interface for digital site data, relevant site background information (hazards, ownership, mineral, costs, etc.), and a structure for future data.

Spatial coordinates for sites were created from newly acquired GPS coordinates and supplemented with historic legal descriptions. These spatial coordinates were used to generate GIS layers, which can change daily "on the fly" from the current database. Using custom forms and SQL queries, a menuing system was created that allows querying of sites based on a variety of information. Additional GIS layers including digital USGS quadrangles (DRGs), roads, elevation, and aerial photography are scale-dependent and added to the project automatically as a user zooms in. Custom programming has also been added to the project to allow the "linking" of other types of non-GIS data to the individual sites, including GPS files, photos, scanned field notes, CAD construction drawings, and other digital files.

WDEQ/AML personnel are able to add new files (photos, GPS, etc.) to the specific site directory and immediately have that information accessible within the GIS. Future plans for the project call for integrating additional types of data (site characterization data, reclamation design drawings, construction as-builts, etc.) as it becomes available. The addition of this supplemental site information creates a true electronic archive and library tool for project management.

INTRODUCTION

The Wyoming Department of Environmental Quality Abandoned Mine Lands Division (WDEQ/AML) required a comprehensively updated statewide database and efficient method to store, retrieve, access, and query pertinent AML site data. To accomplish this task, the existing WDEQ/AML database was updated and redesigned to meet 3 major requirements:

1. Store data generated by ongoing inventory activities and incorporate this information and site data from previously inventoried sites into the WDEQ/AML data base;
2. Use a Geographic Information System (GIS) to create a user-friendly interface, supply query-friendly, real-time location and site-specific information; and
3. Export data to the Office of Surface Mining's (OSM) Abandoned Mine Land Inventory

System (AMLIS) and the Bureau of Land Management's (BLM) abandoned mine database in order to streamline management and funding for reclamation projects.

The project was envisioned to provide WDEQ/AML project managers with an easy to use tool that would enable them to access information about abandoned mine sites quickly. In a state where the ratio of abandoned mine sites to project managers is approximately 500:1, it is critical to properly organize and maintain any existing information about these sites. After researching progress in other states, WDEQ/AML and its database contractors determined that a well-designed database/GIS could ensure that information about individual sites is properly archived and that projects can be more efficiently managed. Also, new agency employees experience a shorter learning curve developing familiarity with the complexities of AML work in Wyoming.

Between 2000 and 2001, AML project teams conducted site visits at priority-abandoned mines throughout the State. As a part of this effort, Lidstone and Associates of Fort Collins, Colorado, the prime inventory contractor, visited and documented approximately 1,013 sites in Wyoming. Field forms, Global Positioning System (GPS) receivers, and digital photographs were used to document current conditions as well as to estimate reclamation costs. WDEQ/AML estimates that an additional 1,500 sites will be inventoried and incorporated into the database in future years. Lidstone and Associates subcontracted with TriHydro Corporation of Laramie, Wyoming to design and program an updated database and create the GIS application.

DATABASE STRUCTURE

A database structure was designed to include information from past surveys and site visits, meet current departmental organizational and query needs, and contain all necessary information for both the BLM and OSM databases. The MS-Access database was revised to consist of a series of linked tables, input forms, and custom reports. The database included information about location of the site, background information, hazards, land ownership, recommended remediation needs, and a reclamation priority assessment. Legal descriptions (township, range, and section locations) were used in a GIS routine to derive latitudinal and longitudinal coordinates for 3,300 existing AML inventoried sites. Using these coordinates, additional database fields were populated from publicly available GIS layers including County, Hydrologic Unit Codes, USGS 1:24,000 quadrangle sheet names, planning unit names, and land ownership. Export tools were created in Access using Visual Basic for Applications (VBA) to create output tables designed to mesh with AMLIS and BLM's database when updates to those databases are necessary.

GIS STRUCTURE

The custom GIS application was developed in ArcView GIS Version 3.2 and was designed to directly link to the MS-Access database (Figure 1). By leaving WDEQ/AML's Access database intact and simply linking to it with the GIS, several goals were achieved. First, a complex database structure using linked tables, defined ranges within fields, field aliases, validation rules, and custom import forms was possible. Secondly, data can be input, updated, and viewed by users without GIS software available. Finally, site data was maintained in only one location reducing the possibility of software version problems. The GIS application provides users with an "always up-to-date" status of AML sites, a user-friendly query system, a single interface for digital data applicable to a given site, relevant site background information (hazards, ownership, minerals, costs, etc.), and a structure for pertinent future AML site-specific data.

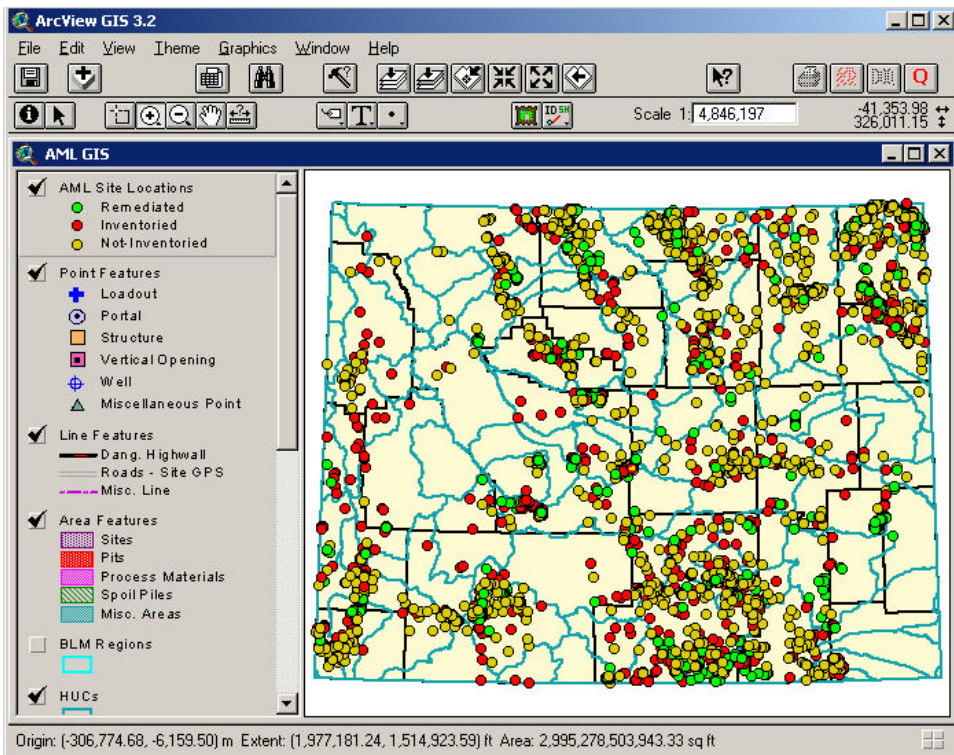


Figure 1: AML GIS Interface

The GIS interface has several key features including a broad suite of publicly available statewide data such as scanned USGS quadrangles at 3 scales (DRGs), aerial photos (DOQQs), streams, roads, watersheds, land ownership, township/range/sections, and counties. Custom programming allows the application to change map projections seamlessly throughout the State. The GIS layers have been designed to be scale-dependent so that the user views only appropriate data for the current view scale. As the user identifies an AML site of interest and zooms to a more local scale, additional GIS layers including digital USGS quadrangles (DRGs), detailed roads, elevation layers, and aerial photography are added to the view automatically.

Finally, the GIS creates an “up-to-minute” layer of AML sites by querying the database each time the GIS is opened. This technique provides users with an “always up-to-date” status of AML sites on which a user-friendly query system can be driven. Using custom forms and SQL queries, a menu system was created which uses custom forms and SQL queries to allow for the querying of mine sites based on a variety of information (Figure 2).

Each site in the State has its own directory, so custom programming will allow the “linking” of other types of non-GIS data to the individual sites such as GPS files, photographs, scanned field notes, CAD construction drawings, and other digital files (site characterization data). In each situation the GIS executes an external piece of software to open the data (e.g. MS-Word or Acrobat to open a report) therefore adding simplicity to the program. WDEQ/AML personnel are able to add new files (photos, GPS, CAD, etc.) to the specific site directory and immediately have that information accessible within the GIS. The addition of this supplemental site information provides a true electronic archive and library tool for project management.

Figure 2: Custom Query Window

CONCLUSIONS

Ultimately the database/GIS combination produced in this project will continue to revolutionize the way work is conducted at WDEQ/AML. The application has already been used to prioritize project sites, based on criteria such as hazards, mineral type, proximity to population areas, and locale. All WDEQ/AML project managers have expressed an eagerness to embrace the product particularly for establishing future budgets, setting up monitoring programs, and tracking reclamation progress.

Work continues to integrate site-specific reclamation/remediation plans into the statewide structure and incorporate improvements. The physical locations and structure of the GIS/database are currently being refined through policy. Separate copies of the GIS application, GIS data, and AML database currently exist at each WDEQ/AML field office. While this structure has advantages in that no network connection is required, it also limits the department's ability to real-time edit the database. Currently quarterly updates are conducted on-site at each field office. Efficiencies may be realized by employing a more network-reliant structure.

FUTURE PLANS

As reclamation/remediation design and site characterization data becomes available it will be added to the GIS application. TriHydro Corporation is currently conducting a pilot effort to create a GIS-based final reclamation/remediation design report for the Sunset Pit in central Wyoming. While functionality currently exists in the project to link and view CAD engineering drawings with a shareware CAD viewer, future goals call for embedding engineering plans within the GIS so that project managers can see proposed topography related to current conditions and analytical sampling data.

Additionally, plans for the project call for the GIS application to be ported to the ArcView 8.3 or 9.0 environment using VBA as its core development tool. Current versions of the ArcView 8.x technology lack the core functionality that was used to develop the project in the 3.x environment. Finally, Wide Area Network (WAN) functionality may be employed in future releases so that a single version of the WDEQ/AML database will reside at a central State-operated server with the field office GIS applications querying remotely. Static GIS layers such as aerial photos, USGS quads, and base layers, may still reside locally in the field office to reduce bandwidth transfers.